

PRICE \$1.00



**Assembling
and Using Your...**

Heathkit

**REFLECTED
POWER METER**

MODEL AM-2

HEATH COMPANY

A Subsidiary of Daystrom Inc.

BENTON HARBOR, MICHIGAN

STANDARD COLOR CODE — RESISTORS AND CAPACITORS

AXIAL LEAD RESISTOR Brown — Insulated Black — Non-insulated Tolerance Multiplier 1st and 2nd Significant Figures Wire wound resistors have 1st digit band double width	<table><thead><tr><th>INSULATED UNINSULATED Color</th><th>FIRST RING BODY COLOR First Figure</th><th>SECOND RING END COLOR Second Figure</th><th>THIRD RING DOT COLOR Multiplier</th></tr></thead><tbody><tr><td>BLACK</td><td>0</td><td>0</td><td>None</td></tr><tr><td>BROWN</td><td>1</td><td>1</td><td>0</td></tr><tr><td>RED</td><td>2</td><td>2</td><td>00</td></tr><tr><td>ORANGE</td><td>3</td><td>3</td><td>,000</td></tr><tr><td>YELLOW</td><td>4</td><td>4</td><td>0,000</td></tr><tr><td>GREEN</td><td>5</td><td>5</td><td>00,000</td></tr><tr><td>BLUE</td><td>6</td><td>6</td><td>000,000</td></tr><tr><td>VIOLET</td><td>7</td><td>7</td><td>0,000,000</td></tr><tr><td>GRAY</td><td>8</td><td>8</td><td>00,000,000</td></tr><tr><td>WHITE</td><td>9</td><td>9</td><td>000,000,000</td></tr></tbody></table>	INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier	BLACK	0	0	None	BROWN	1	1	0	RED	2	2	00	ORANGE	3	3	,000	YELLOW	4	4	0,000	GREEN	5	5	00,000	BLUE	6	6	000,000	VIOLET	7	7	0,000,000	GRAY	8	8	00,000,000	WHITE	9	9	000,000,000	DISC CERAMIC RMA CODE 5-Dot 3-Dot Capacity Multiplier Tolerance Temp. Coeff.
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The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heath-kits are $\frac{1}{2}$ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors $\frac{1}{2}$ watt, 1 or 2 watt may be color coded but the first band will be double width.

MOLDED MICA TYPE CAPACITORS

CURRENT STANDARD CODE White (RMA) Black (JAN) Class Tolerance 1st / 2nd } Significant Figure Multiplier JAN & 1948 RMA CODE RMA 3-DOT (OBSOLETE) RATED 500 W.V.D.C. $\pm$ 20% TOL. Multiplier 2nd / 1st } Significant Figure BUTTON SILVER MICA CAPACITOR Class Tolerance Multiplier 3rd digit 1st Digit 2nd Digit
RMA (5-DOT OBSOLETE CODE) 1st / 2nd } Significant Figure Multiplier Front Working Voltage Rear Tolerance Working Voltage Tolerance Multiplier 1st / 2nd } Significant Figure Working Voltage Blank RMA 6-DOT (OBSOLETE) 1st / 2nd / 3rd } Significant Figures Multiplier Tolerance Working Voltage RMA 4-DOT (OBSOLETE) Working Voltage Multiplier 2nd / 1st } Significant Figure

MOLDED PAPER TYPE CAPACITORS

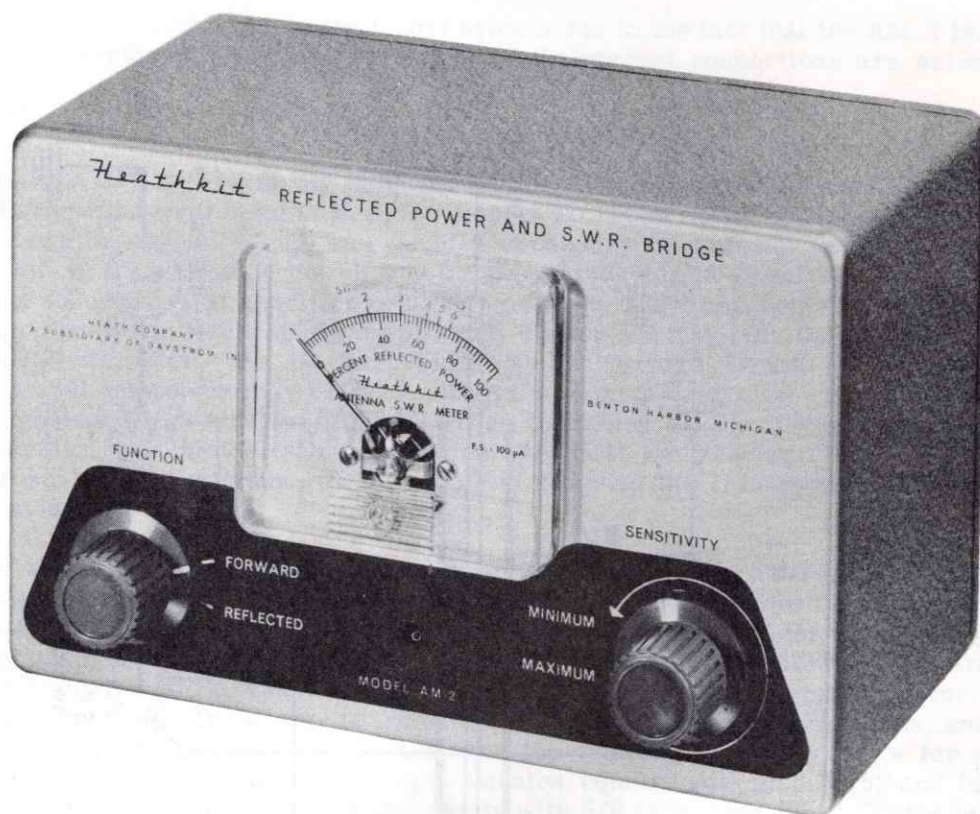
TUBULAR CAPACITOR Normally stamped for value. A 2 digit voltage rating indicates more than 900 V. Add 2 zeros to end of 2 digit number.	MOLDED FLAT CAPACITOR Commercial Code 	JAN. CODE CAPACITOR
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The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3×100 or 300 volts. Blue = 6×100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

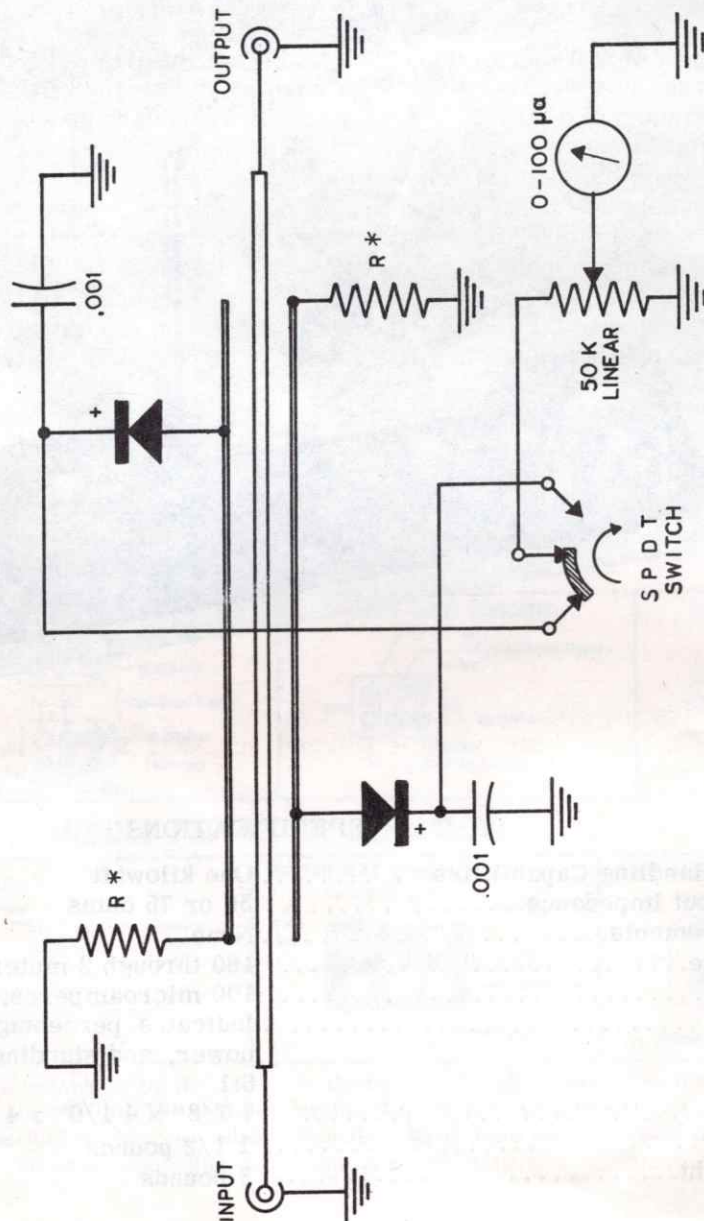
Courtesy of Central

ASSEMBLY AND OPERATION OF THE HEATHKIT REFLECTED POWER METER MODEL AM-2



SPECIFICATIONS

R. F. Power Handling Capabilities.....	One kilowatt
Input and Output Impedance.....	50 or 75 ohms
Power Requirements.....	None
Band Coverage.....	160 through 2 meters
Meter.....	100 microamperes, full scale
Operation.....	Indicates percentage of forward and reflected power, and standing wave ratio from 1:1 to 6:1
Cabinet Size.....	7 3/8" x 4 1/6" x 4 5/8"
Net Weight.....	1 1/2 pounds
Shipping Weight.....	3 pounds



*** NOTE**

R = 100Ω or 150Ω

Two 100Ω resistors and two 150Ω resistors are included in the kit.

The 100Ω resistors are used for 75Ω input and output.

The 150Ω resistors are used for 50Ω input and output.

HEATHKIT REFLECTED POWER
AND STANDING WAVE RATIO BRIDGE
MODEL AM-2

INTRODUCTION

The Heathkit Model AM-2 is a device to ascertain the efficiency of an antenna by measuring the Forward and Reflected Power or Standing Wave Ratio in the radiator and feed line configuration.

A very desirable feature of the unit is its power handling capabilities. The AM-2 is designed to handle a peak power of well over one kilowatt of energy and may be left in the antenna system feed line at all times.

Another application for the AM-2 is matching impedances between exciters or R. F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two.

No insertion loss is introduced into the feeder system due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line.

CIRCUIT DESCRIPTION

Circuit-wise the AM-2 is extensively modified from the original Naval Research Laboratory design by NorGorden and written up in N. R. L. Report No. 3538 titled "A Reflectometer for H-F Band". In designing the AM-2, it was decided necessary to compact the unit. The unit is simply a section of transmission line to which a linear inductor is closely coupled, providing a combination of inductive and capacitive coupling. As such, the component of RF existing on the line is balanced out when the constants are properly chosen, leaving only the reflected component to actuate an RF voltmeter. The AM-2 combines two such bridge circuits so that either the incident or reflected component may be read. With this type of bridge the current flowing in the indicator circuit is a direct function of the operating frequency, so the circuit uses an adjustable resistor in parallel with the indicating instrument to adjust the reading from "off-scale" to a desirable full scale reading without the necessity of reducing the transmitter output to acquire the proper "on-scale" level.

Some thought was given to perhaps include in the meter calibration, a direct reading power indicator. This is very involved because dependence of voltmeter readings on frequency makes a direct power calibration impracticable. The instrument is nevertheless capable of performing the really important functions of determining and monitoring a "match". Relative power output also is indicated. The transmission-line section has a characteristic impedance equal to that of the actual line. The design of the AM-2 works well with 50 or 75Ω lines, and does not introduce a perceptible Standing Wave Ratio over the primary frequency range for which the AM-2 was designed. Incidentally, the bridge operates equally well on both 50 and 144 megacycles. The line section consists of a metal cavity with 5/8 inch sides for the outer conductor, and a length of 1/4 inch tubing centered in the cavity as the inner conductor. The bridge links are 2 pieces of #14 wire 4 inches in length and spaced 1/8 inch from the center conductor by three plastic insulators.

The bridge circuits are connected to the pickup links. Their circuitry consists of one capacitor, one diode and one resistor. Four resistors are furnished in the kit for termination of the bridge and the proper ones must be selected to match the characteristic impedance of your antenna system. 100Ω resistors are used for a system of 75Ω and the 150Ω resistors are used for 50Ω installations. (We suggest the unused set be taped to the bottom of the cabinet for future utilization.)

The theory of the function of the bridge is simple. The antenna current should flow in only one direction for maximum antenna efficiency, if, however, a portion of the power is restricted by a mismatch, it reverses and follows the line back to the generating source. This effect is referred to as reflected power. If forms of demodulation and indication are provided, reading of the ratio of two voltages result.

The pickup links are reversed in polarity and their functions are entirely independent of each other, thus with the bridge circuitry and impedance termination, this condition is met. The pickup link is acting as an inductance loosely coupled to the center conductor of the coaxial line. The diode is connected to the pickup link and rectifies any voltage that may appear in the link, this voltage results in a reading on the meter. Two of these circuits connected in reverse to each other indicates their respective voltages.

A means of switching the meter to read either of these voltages is provided in the unit. A linear control adjusts the meter to its scale limits alleviating the necessity of adjusting the transmitter to a certain power for full scale readings.

If all adjustments and instructions are followed as outlined in the "Operation" section of this manual, an accurate reading on the function of the antenna configuration is available at all times.

NOTES ON ASSEMBLY AND WIRING

The components furnished with your AM-2 are of excellent electrical quality and are reasonably strong. However, all parts should be handled with due care and consideration for the weak points inherent in some components. Bend leads and mount parts to comply with the artists drawing.

This manual is supplied to assist you in every way to complete the instrument with the least possible chance for error. We suggest that you take a few minutes now and read the entire manual through before any work is started. This will enable you to proceed with the work much faster when construction is started. The large fold-in pictorials are handy to attach to the wall above your work space. Their use will greatly simplify the completion of the kit. These diagrams are repeated in smaller form within the manual. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with each part. Refer to the charts and other information shown on the inside covers of the manual to help you identify any parts about which there may be a question. If some shortage is found in checking the parts, please notify us promptly and return the inspection slip with your letter to us. Hardware items are counted by weight and if a few are missing, please obtain them locally if at all possible.

Resistors and controls generally have a tolerance rating of $\pm 20\%$ unless otherwise stated in the parts list. Therefore a 100 K Ω resistor may test anywhere from 80 K Ω to 120 K Ω . (The letter K is commonly used to designate a multiplier of 1000.) Tolerances on capacitors are generally even greater. Limits of +100% and -50% are common for electrolytic capacitors. The parts furnished with your Heathkit have been specified so as to not adversely affect the operation of the finished instrument.

In order to expedite delivery to you, we are occasionally forced to make minor substitutions of parts. Such substitutions are carefully checked before they are approved and the parts supplied will work satisfactorily. These changes are self-evident and are mentioned here only to prevent confusion in checking the contents of your kit.

NOTES ON WIRING

Read the notes on soldering and wiring on the inside rear cover. Crimp all leads tightly to the terminal before soldering. Be sure both the lead and terminal are free of wax, corrosion or other foreign substances. Use only the best rosin core solder, preferably a type containing the new activated fluxes such as Kester "Radio-TV Solder," Ersin "Multicore" or similar types.

Unless otherwise indicated, all wire used is insulated. Wherever there is a possibility of the bare leads on resistors and capacitors shorting to other parts or to chassis, the leads should be covered with insulated sleeving. This is indicated in the instructions by the phrase "use sleeving." Bare wire is used where the lead lengths are short and the possibility of short circuits are non-existent.

Leads on resistors, capacitors and transformers are generally much longer than they need to be to make the indicated connections. In these cases, the excess leads should be cut off before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points. Not only does this make the wiring much neater but in many instances, the excessively long leads will actually interfere with proper operation of the instrument.

The pictorials indicate actual chassis wiring and designate values of the component parts. We very strongly urge that the chassis layout, lead placement and grounding connections be followed exactly as shown. While the arrangement shown is probably not the only satisfactory layout, it is the result of considerable experimentation and trial. If followed carefully, it will result in a stable instrument operating at a high degree of accuracy and dependability.

Space has been provided for you to check off each operation as it is completed. This is particularly important in wiring and it may prevent omissions or errors, especially where your work is interrupted frequently as the wiring progresses. Some kit builders have also found it helpful to mark each lead in colored pencil on the pictorial as it is added.

PROPER SOLDERING PROCEDURE

Only a small percentage of Heathkit purchasers find it necessary to return an instrument for factory service. Of these, by far the largest proportion function improperly due to poor or improper soldering.

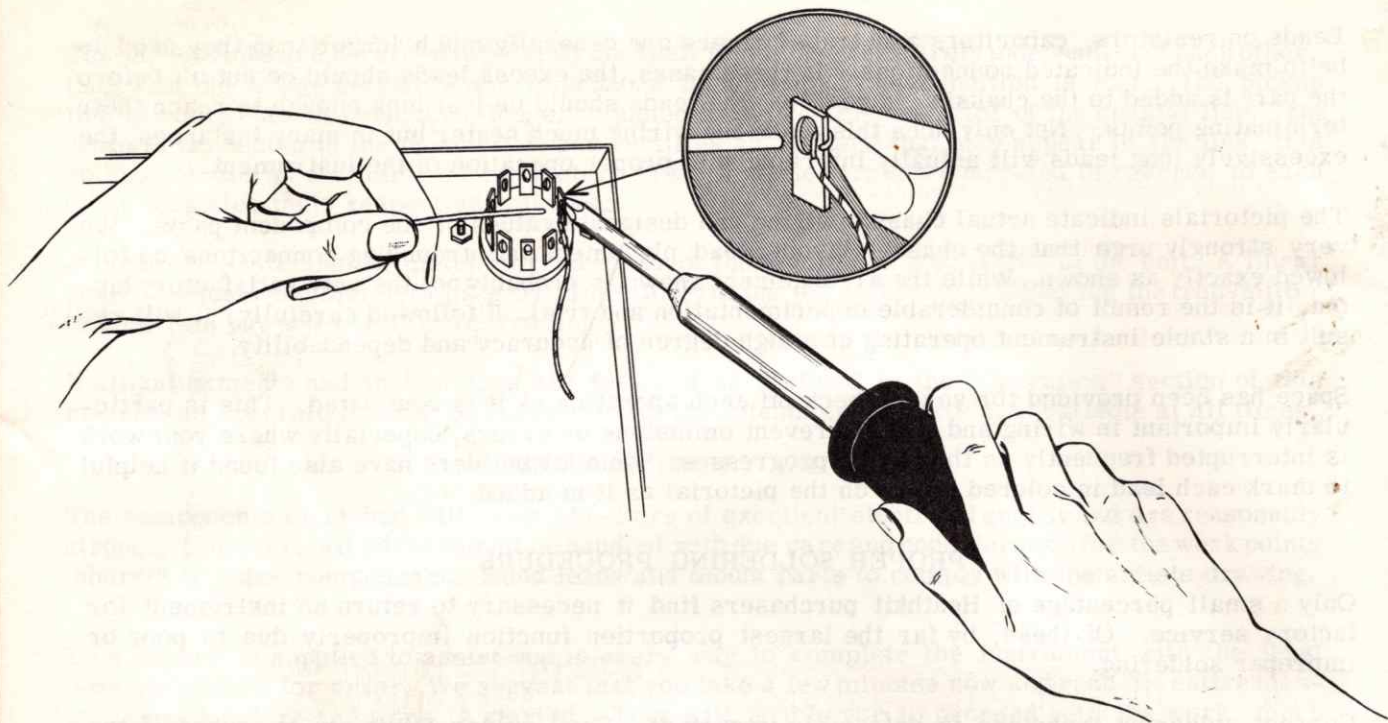
Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized. If you are a beginner with no experience in soldering, a half-hour's practice with odd lengths of wire and a tube socket will be a worthwhile investment.

High quality solder of the proper grade is most important. There are several different brands of solder on the market, each clearly marked "Rosin Core Radio Solder." Such solders consist of an alloy of tin and lead, usually in the proportion of 50:50. Minor variations exist in the mixture such as 40:60, 45:55, etc. with the first figure indicating the tin content. Radio solders are formed with one or more tubular holes through the center. These holes are filled with a rosin compound which acts as a flux or cleaning agent during the soldering operation.

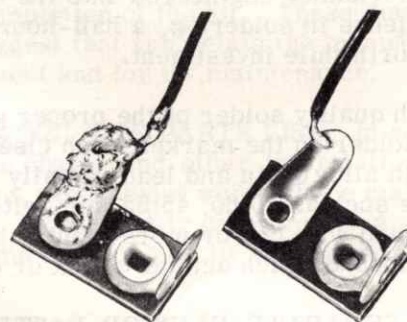
NO SEPARATE FLUX OR PASTE OF ANY KIND SHOULD BE USED. We specifically caution against the use of so-called "non-corrosive" pastes. Such compounds, although not corrosive at room temperatures, will form residues when heated. The residue is deposited on surrounding surfaces and attracts moisture. The resulting compound is not only corrosive but actually destroys the insulation value of non-conductors. Dust and dirt will tend to accumulate on these "bridges" and eventually will create erratic or degraded performance of the instrument.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

If terminals are bright and clean and wires free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Crimp or otherwise secure the wire (or wires) to the terminal, so a good joint is made without relying on solder for physical strength. To make a good solder joint, the clean tip of the soldering iron should be placed against the joint to be soldered so that the terminal is heated sufficiently to melt solder. The solder is then placed against both the terminal and the tip of the iron and will immediately flow out over the joint. Refer to the sketch below. Use only enough solder to cover wires at the junction; it is not necessary to fill the entire hole in the terminal with solder. Excess solder may flow into tube socket contacts, ruining the socket, or it may creep into switch contacts and destroy their spring action. Position the work so that gravity tends to keep the solder where you want it.



A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified is another evidence of a "cold" connection. In either event, reheat the joint until the solder flows smoothly over the entire junction, cooling to a smooth, bright appearance. Photographs in the adjoining picture clearly indicate these two characteristics.



A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 60 or 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Smaller irons generally will not heat the connections enough to flow the solder smoothly over the joint and are recommended only for light work, such as on etched circuit boards, etc. Keep the iron tip clean and bright. A pad of steel wool may be used to wipe the tip occasionally during use.

Take these precautions and use reasonable care during assembly of the kit. This will insure the satisfaction of having the instrument operate perfectly the first time it is used.

STEP-BY-STEP ASSEMBLY INSTRUCTIONS

The abbreviation "NS" indicates that the connection should not be soldered as yet, for other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number appears after each solder (S) instruction. This number indicates the number of leads connected to the terminal in question. For example, if the instructions read, "Connect a 47 K Ω resistor from socket E1 (S-2) to E6 (NS)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. This additional check will help avoid errors.

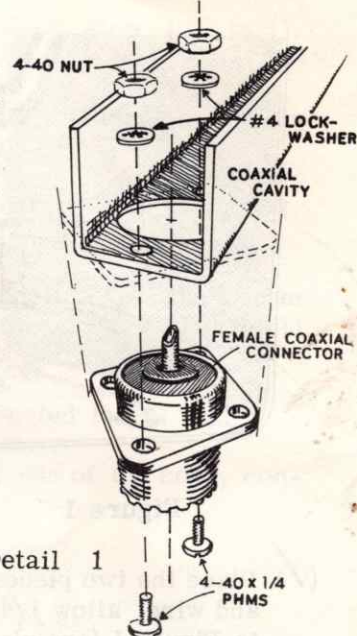
We suggest you do the following before any work is started:

1. Attach the large fold-in pictorials to the wall above your work bench.

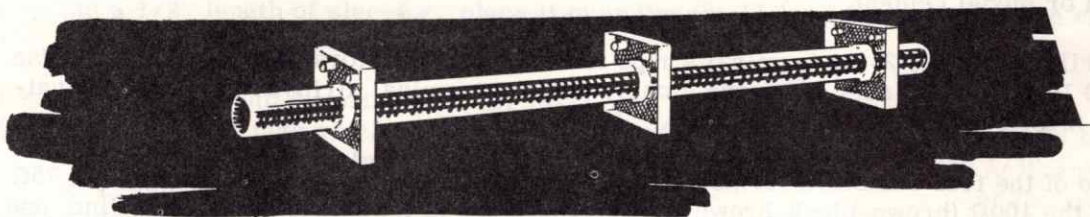
2. Go through the entire assembly and wiring instructions. This is an excellent time to read the entire instruction section through and familiarize yourself with the procedure.
3. Lay out all parts so that they are readily available. Refer to the general information inside the front and back covers of this manual to help you identify components.

The following instructions are presented in a simple, logical, step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before you start to do it. When the step is completed, check it off in the space provided.

- () Install coaxial connectors as shown in Detail 1, using 1/4" 4-40 bolts, #4 washers and nuts.
- () Place the three plastic spacers on the driver element (tubing). Refer to Detail 2.
- () Turn the plastic spacers on the copper rod until the small holes are all in alignment.



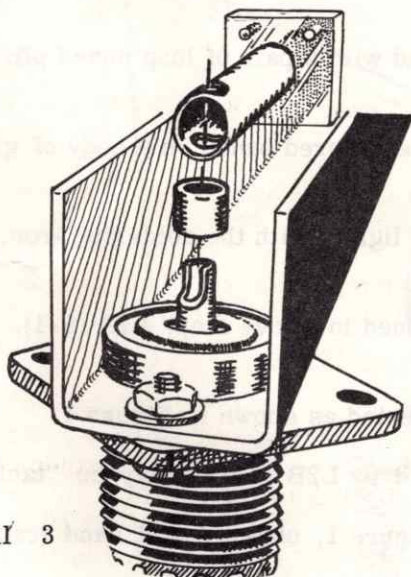
Detail 1



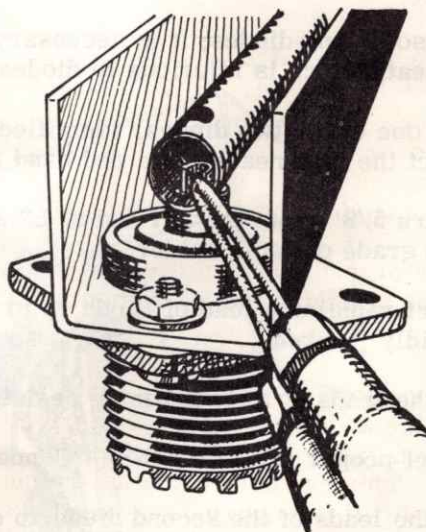
Detail 2

PLACEMENT OF SPACERS

- () Place the small round metal spacers on the coaxial connector terminals as shown in Detail 3.
- () Install the driver element (tubing) in place, being sure the small holes in the plastic spacers are in the opening of the cavity as shown in Detail 3.



Detail 3



Detail 4

- () Solder each end of the driver in place. Make sure the plastic spacers are moved to the opposite end (they can be damaged by heat). Refer to Detail 4 for soldering of driver to coax terminal.

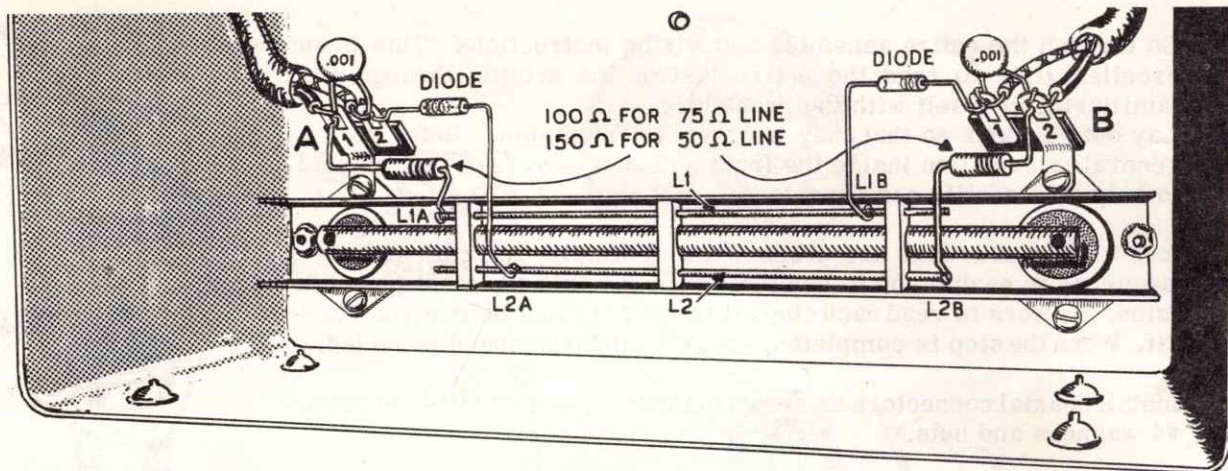


Figure 1

- (✓) Place the two pieces of #14 wire through the holes in the plastic spacers. Center the spacers and wire, allow 1/4 inch of wire outside of the end spacers for connection of parts. Refer to Figure 1 (completed bridge). Spacers may be held in place with a tiny dot of nail polish, household or model cement.
- (✓) Temporarily fasten the 2-lug terminal strips to the coax connectors at points A and B. Use 1/4" 4-40 PHMS and #4 nuts. Observe closely that the terminal strips are reversed physically and must conform with Figure 1.
- (✓) Select two of the four resistors furnished with the kit. If the AM-2 is to operate on a 75Ω line, use the 100Ω (brown-black-brown) resistors. If the AM-2 is used with a 50Ω line, use the 150Ω (brown-green-brown) resistors. Fasten the two unused resistors to the bottom or side of the cabinet with a piece of scotch or similar tape. (They may be needed at a future date.)
- (✓) Cut and form the leads of one of these resistors to conform with Figure 1. Connect one end to A1 (NS). Connect opposite end to L1A (S-1). A solid "tacking" technique is adequate. Solder the resistors to the end of the pickup link.

NOTE: In soldering diodes, it is necessary to grasp the lead with a pair of long nosed pliers to dissipate heat, which is injurious to diodes.

- (✓) Select one of the two diodes, identified by observing the colored bands on a body of glass.
- (✓) Connect the lead nearest the red band to A2 (NS).
- (✓) Measure 5/8" from the left end of L2 and tin this point lightly with the soldering iron. Use a good grade of radio solder.
- (✓) Connect remaining lead of Diode #1 to the point mentioned in above step, L2A (S-1). May be solidly "tacked".
- (✓) Bend the leads of the remaining resistor of the set selected as shown in Figure 1.
- (✓) Connect proper end to B2 (NS). Connect remaining end to L2B (S-1). May be "tacked".
- (✓) Bend the leads of the second diode to conform with Figure 1, observe red band (cathode) marking.
- (✓) Connect the lead nearest the red band to B1 (NS).
- (✓) Measure 5/8" from the right end of L1 and tin this point lightly.

- (✓) Connect remaining lead of Diode #2 to the L1B point mentioned in above step, L1B (S-1). May be "tacked".
- (✓) Cut both leads of a .001 disc ceramic capacitor to approximately 3/8". Insert one lead in A1 lug (NS) and the other lead is inserted at A2 lug (NS). Crimp ends of leads lightly.
- (✓) Duplicate above step with the remaining .001 disc ceramic except install it at B1 and B2. Refer to Figure 1 on the above steps.
- (✓) Cut a 6 1/2" length of the RG58A/U coaxial cable. Trim outside insulation 3/4" back from end, unbraid shield with a sharp instrument to the outside insulation. Twist the shield wires together, strip the insulation from the center conductor 3/16".
- (✓) Prepare the opposite end of the coax as instructed above, to be connected later.
- (✓) Cut a 1/2" length of sleeving and place it over the shield lead of one end of the coax, connect to A1 (S-3).
- (✓) Connect the center conductor to A2 (S-3).
- (✓) Cut a 10" length of RG58A/U coaxial cable and prepare both ends as above.
- (✓) Cut a 1/2" length of sleeving, place it over the shield lead of one end of the coax, connect it to B2 (S-3).
- (✓) Connect the center conductor to B1 (S-3).
- (✓) Remove the #4 nuts which temporarily held the 2-lug terminal strips and install the completed bridge in the cabinet. Install assembly to conform with Figure 1. Use 1/4" 4-40 PHMS, #4 lockwashers and #4 nuts.

All cabinet wiring is completed at this point.

ASSEMBLING AND WIRING THE PANEL

Study briefly, the placement of parts on the front panel as shown in Figure 2.

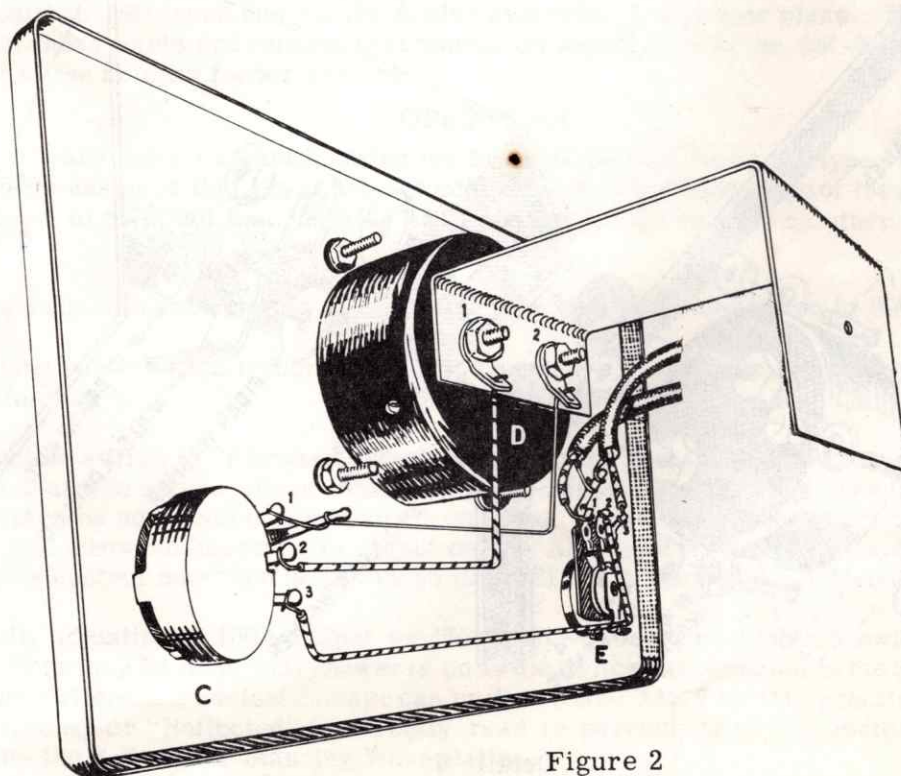
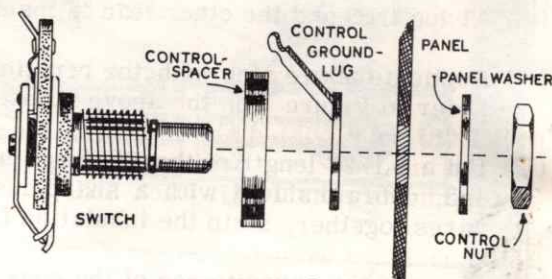
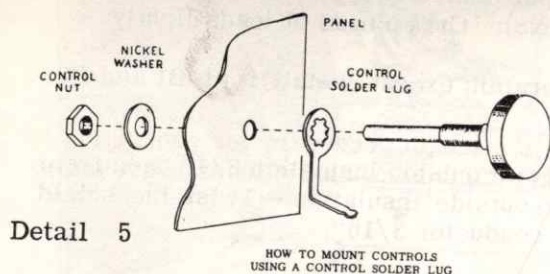
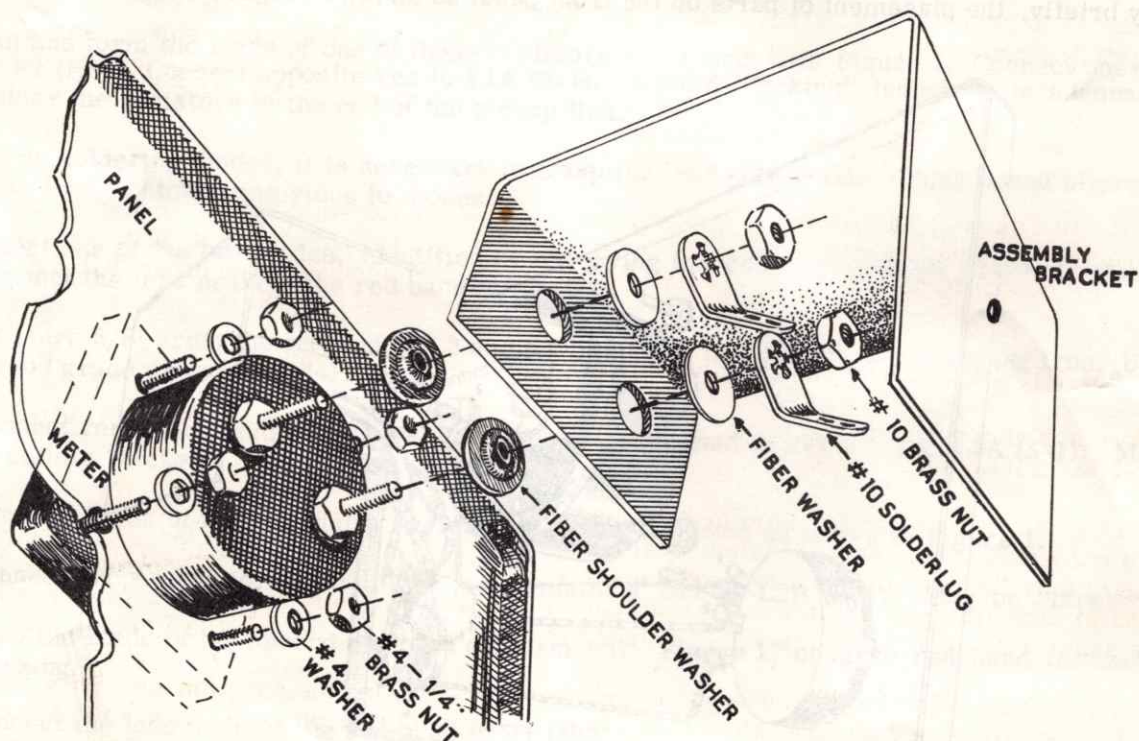


Figure 2

- (✓) Install the 50K linear control. Refer to Detail 5. Place control, ground lug, washer and nut as indicated. Ground lug positioned nearest to C1.



- (✓) Install single pole double throw switch as shown in Detail 6.
- (✓) Mount the meter with washers and nuts furnished.
- (✓) Install assembly bracket as shown in Detail 7. It is important that the hardware is assembled in proper sequence to result in exact spacing between front and back panels. Make sure that assembly bracket is seated over pilot shoulder on the 1/16" #10 fibre washer.
- (✓) Cut a 4" length of the bare wire. Connect one end to the 50K linear control C1 (S-1). Wrap bare wire once around ground lug at soldering point (S-1). Bend remainder of wire as shown in Figure 2 and connect to meter lug D2 (S-1).
- (✓) Cut a 3" length of plastic coated wire, strip ends to 3/16". Dress as shown in Figure 2. Connect one end to C2 (S-1) and the other end is connected to D1 (S-1).
- (✓) Cut a 5 1/4" length of plastic coated wire, strip ends to 3/16". Dress as shown in Figure 2. Connect one end to center terminal of switch E2 (S-1). Connect the other end to the 50K control C3 (S-1).



- () Place the cabinet on its left end, locate the front panel near the cabinet front with the function switch nearest the cabinet opening to facilitate connection of the coaxial cables to the switch.
- () Connect the center conductor of the shortest cable to switch terminal E1 (S-1).
- () Connect the center conductor of the longer cable to switch terminal E3 (S-1).
- () Trim both twisted shield lead of the coaxial cable to the length necessary for connecting to the grounding lug held in place by the switch. Connect the coaxial shield leads to grounding lug held in place by switch E (S-2).

This concludes wiring detail.

- () Dress coax cables to clear components of the bridge unit and assemble front panel to cabinet.
- () Secure the front panel in place with the self-threading metal screw through the back panel and assembly bracket.
- () Install the four rubber feet through the openings provided in the bottom of the cabinet.
- () Check rotation of controls and panel marking, install knobs on their respective shafts. Tighten set screws.
- () Install the "input" label on the back of the cabinet, above the coax connector at the left (looking at the back of the cabinet).
- () The "output" label is placed above the remaining connector.

This completes construction of the AM-2.

Detail 8

INSTALL FEET
AS SHOWN



CONNECTION TO THE TRANSMITTER

The AM-2 is connected in series with the antenna feeding system. Input and output coaxial connectors are provided at the rear of the AM-2. Situate your AM-2 in a convenient location at the operating position. Measure and cut the feeder system at the proper place. Install male coax connectors at these points and connect the transmitter output lead to the AM-2 input, connect the AM-2 output to the antenna feeder system.

OPERATION

The Heath Company has no way of knowing the brand of equipment or the type of feed line used. Therefore, it is assumed that the constructor of the AM-2 has knowledge of these details. However, we hasten to point out that the AM-2 will not operate accurately on other than 50Ω or 75Ω lines.

The AM-2 is utilized by connecting as outlined in the heading "Connection to the Transmitter."

Before applying power to the transmitter, it is necessary to turn the sensitivity control on the AM-2 to "Minimum".

Turn the function switch to "Forward", apply power to the transmitter and "tune it up". Disregard the AM-2 at this stage. After considering the transmitter properly tuned, the sensitivity control may then be advanced to a mid-scale reading. Another minor "touch-up tuning" of the transmitter will show an increase in output on the AM-2. This indicates a closer "match". The sensitivity control may then be advanced to a full scale reading or 100% output.

After carefully adjusting to 100% output or "forward" power, the function switch is turned to "Reflected" (this may be done while power is on as the switch is connected in the low power bridge circuit and no switching transient damage can be done to the AM-2 by this practice). The amount of power returning or "Reflected" is directly read in percentage on the meter, which is also referred to as the S. W. R. or Standing Wave Ratio.

The AM-2 is so designed that it may be left in the transmission line at all times. A continuous monitor of the operation of the antenna is at hand, merely by observing the AM-2. A power output of 70 watts is needed on 75 meters for 100% or full-scale deflection in contrast to 2 or 3 watts at 2 and 6 meters, for full-scale deflection.

As the transmitter is being voice modulated, a slight downward deflection of the meter will be indicated. This will occur when the function switch is on the "Forward" position and should not be confused with "Downward Modulation". This effect is traced to a non-linear condition between voltage and current developed in the final amplifier of the transmitter, and should not alarm the operator, as it is entirely normal with high level modulation. Low level and efficiency modulation will "kick" the meter indication up, on peaks.

IN CASE OF DIFFICULTY

Mistakes in wiring or poorly soldered connections are the most common causes of difficulty. Consequently, the first step is to recheck all wiring against the pictorial and schematic diagram. Often having a friend check the wiring will locate an error consistently overlooked.

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

- A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
- B. Identify the type and model number of kit in which it is used.
- C. Mention the order number and date of purchase.
- D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. If tubes are to be returned, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

In event continued operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal: Your instrument may be returned for inspection and repair for a service charge of \$3.00 plus the cost of any additional material that may be required. **THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL.** Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned not repaired.

The Heath Company is willing to offer its full cooperation to assist you in obtaining the specified performance level in your instrument. Factory repair service is available for a period of one year from the date of purchase or you may contact the Engineering Consultation Department by mail. For information regarding possible modification of existing kits, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at any electronic outlet store. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for specific purposes. Therefore, such modifications must be made at the discretion of the kit builder according to information which will be much more readily available from some local source.

SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted.

ATTACH A TAG TO THE INSTRUMENT GIVING
NAME, ADDRESS AND TROUBLE EXPERIENCED.

Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

SPECIFICATIONS

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

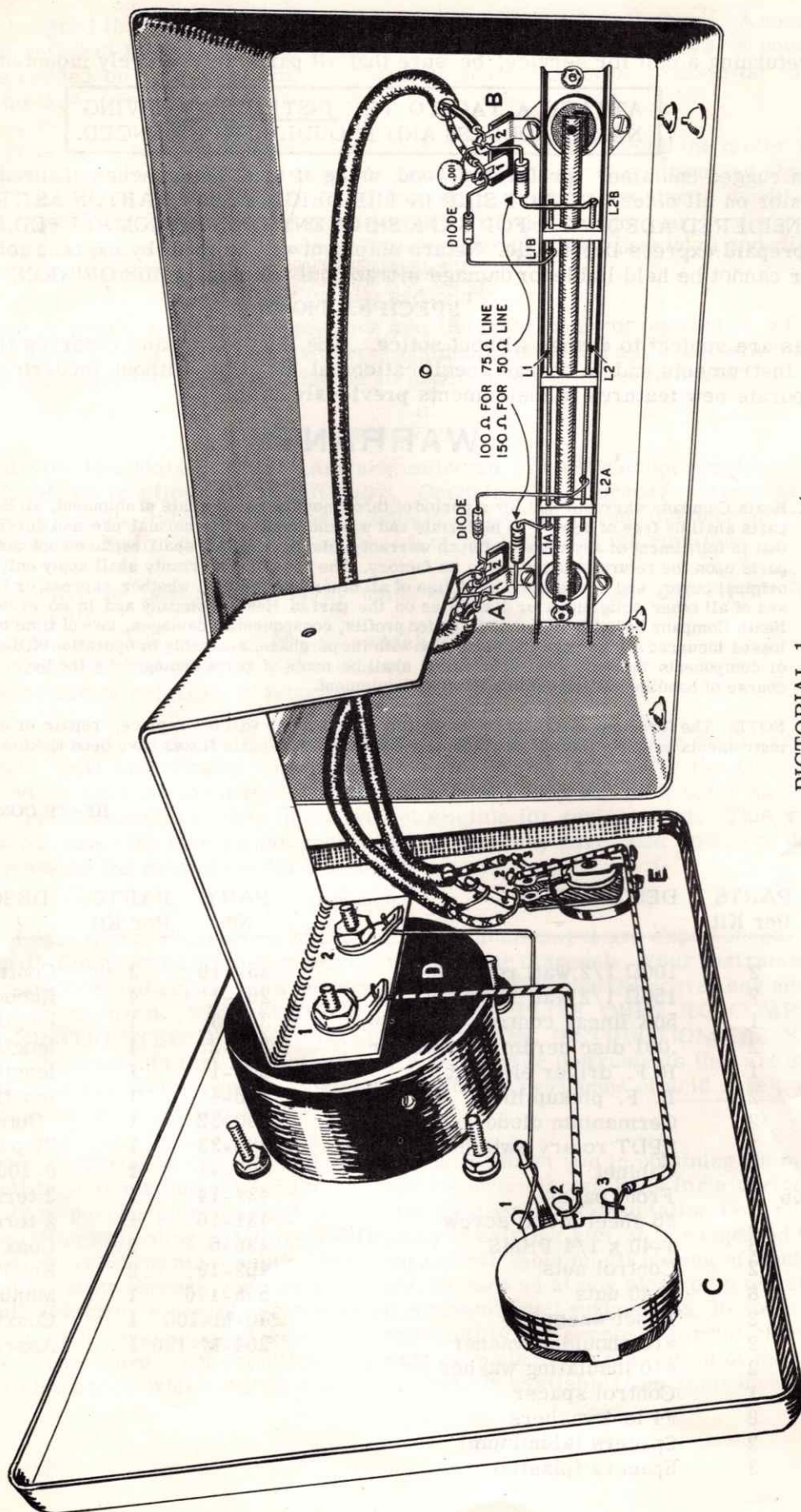
WARRANTY

Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

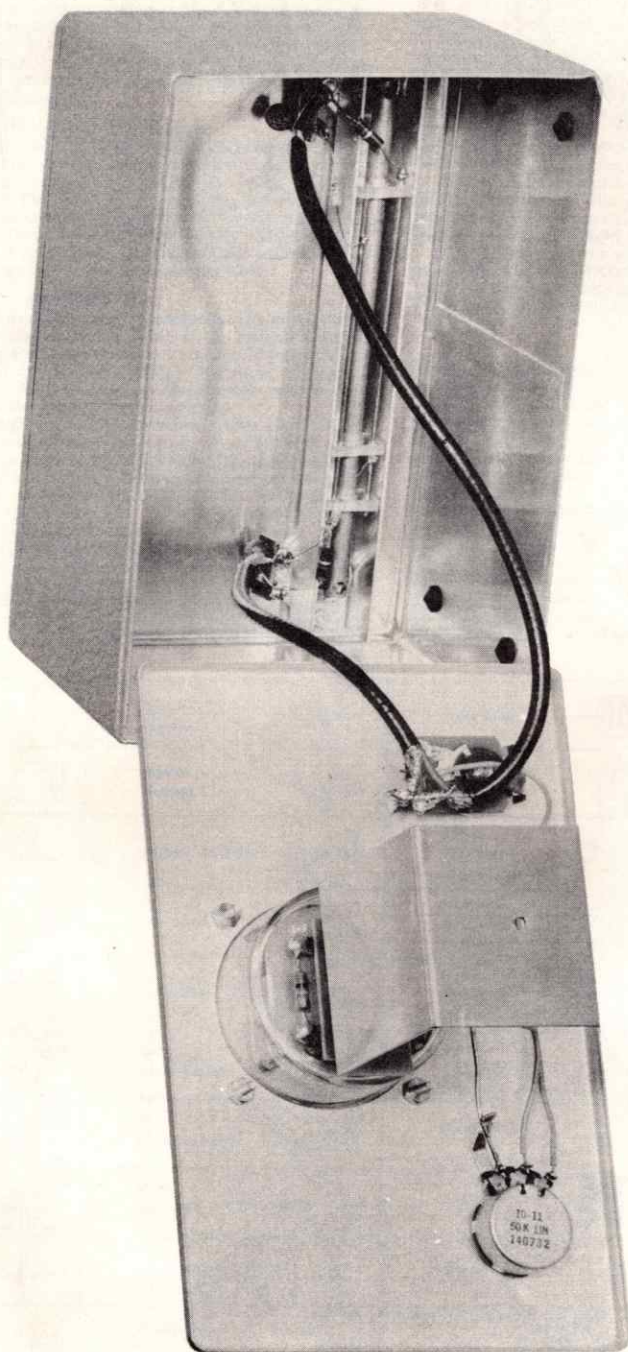
NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
1-3	2	100Ω 1/2 watt resistor	259-10	2	Control lugs
1-66	2	150Ω 1/2 watt resistor	261-1	4	Rubber feet
10-11	1	50K linear control	340-3	1	length #16 bare wire
21-14	2	.001 disc ceramic capacitor	343-2	1	length coax cable
40-98	1	R. F. driver element	344-1	1	length hookup wire
40-99	2	R. F. pickup link	346-4	1	length sleeving
56-4	2	Germanium diode	390-32	1	"Output" label
63-3	1	SPDT rotary switch	390-33	1	"Input" label
90-64	1	Cabinet	407-43	1	0-100 ua meter
203-125F166	1	Front panel	431-14	1	2 terminal lug strip
250-8	1	#6 sheet metal screw	431-16	1	2 terminal lug strip
250-52	8	4-40 x 1/4 PHMS	436-5	2	Coax connectors
252-7	2	Control nuts	462-19	2	Knobs (pointer)
252-15	8	4-40 nuts	595-176	1	Manual
253-10	2	Panel washers	40-M-100	1	Coaxial cavity
253-7	2	#10 shoulder washer	204-M-136	1	Assembly bracket
253-3	2	#10 insulating washer			
253-22	1	Control spacer			
254-9	8	#4 lockwashers			
255-2	2	Spacers (aluminum)			
255-12	3	Spacers (plastic)			



PICTORIAL 1



HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.

Antenna General		Resistor General		Neon Bulb		Receptacle two-conductor	
Loop		Resistor Tapped		Illuminating Lamp		Battery	
Ground		Resistor Variable		Switch Single pole Single throw		Fuse	
Inductor General		Potentiometer		Switch double pole single throw		Piezoelectric Crystal	
Air core Transformer General		Thermistor		Switch Triple pole Double throw		1000 =	K
Adjustable Powdered Iron Core		Jack two conductor		Switch Multipoint or Rotary		1,000,000 =	M
Magnetic Core Variable Coupling		Jack three conductor		Speaker		OHM =	Ω
Iron Core Transformer		Wires connected		Rectifier		Microfarad =	MF
Capacitor General		Wires Crossing but not connected		Microphone		Micro Microfarad =	MMF
Capacitor Electrolytic		A. Ammeter V. Voltmeter		Typical tube symbol 		Binding post Terminal strip	
Capacitor Variable		G. Galvanometer mA. Milliammeter uA. Microammeter, etc.				Wiring between like letters is understood	

Courtesy of I. R. E.

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